Point Barrow Geomagnetic Observatory

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As part of the U.S. Navy's Ice Experiment 1-91, a permanent Geomagnetic Observatory was established at Point Barrow, Alaska, on March 21, 1991. The Point Barrow Geomagnetic Observatory (PBGMO) was designed and established by Naval Surface Warfare Center (NSWC), Electromagnetic Fields Branch, to be a permanent facility that acquires ambient noise using state-of-the-art and experimental magnetic sensors. This program is sponsored by the Office of Naval Research, Ocean, Atmosphere, and Space Science Technology Department. The observatory was established to measure the high level geomagnetic activity (1991 to 1993) generally associated with sunspot maximum periods and to provide data for at least the next decade. The PBGMO sensors are located on U.S. Air Force property, near the NOAA Climate Monitoring and Diagnostics Laboratory that provides support and housing for the observatory electronics. The U.S. Geological Survey's geomagnetic observatory is about 1/2 km west and uses less sensitive proton precession magnetometers.

The PBGMO has three helium-3 magnetometers and three triaxial fluxgate magnetometers arranged to form two orthogonal gradiometer axes, north-south and east-west magnetic with baselines of 152 m (500 feet). The sensor and its electronics are mounted on a tray inside a PVC tube that is put inside a 203-mm (8-inch) diameter fiberglass waterproof housing. The fiberglass tube has a welded aluminum pipe shield (open ends) and is put inside a non-magnetic wooden box. A non-magnetic wooden fence was built around the sensor to mark its location and protect it from animals and adventuresome snowmobilers. Two RG-8/U cables are required to provide power to and obtain signals from each sensor. The six cables are routed to the CMDL facility building where NOAA has provided NSWC with a table in a corner of one room and access to a phone line. The U.S. Air Force Long Range Radar Site provides space for storage, lodging, and other logistical support.

Data from the Point Barrow helium-3 and fluxgate sensors are recorded on magnetic tape cartridges (March 1991 to January 1994) and most recently, (January 1994 to present) on optical disk storage medium because of the volume of data obtained from continuously sampling the ambient noise and to easily access data records. Data tapes and cartridges have been shipped to NSWC, White Oak site by NOAA personnel.

The PBGMO electronics were originally designed to pump the helium-3 sensors once a day, assuming the helium-3 nuclear magnetic resonance magnetometer T2 times would be greater than 24 hours. Unfortunately, only one of the three worked reliably greater than 24 hours, so a 12-hour repump time was programmed, resulting in a 10-minute loss of data from an otherwise continuous data record. Trips to repair one helium-3 sensor and up-grade software, electronics, and assure that sensors have greater than 12 hours T2 time were made on September 30, 1991, and again in January 1994. The helium-3 magnetometers, designed and built by Texas Instruments, Inc., McKinney, Texas, have a noise level of nominally 1 picotesla. (1 picotesla = 10^{-8} Oersted= 10^{-3} nanotesla = 10^{-3} gamma).

All observatory functions are controlled by a type 386 personal computer with a magnetic tape drive and a Ricoh Optical Drive, uninterruptable power supply, modem phone line for program control, and instant access from White Oak. An electronics power supply sensor interface cabinet contains three power supplies that power each sensor separately.

THE DATA

The initial measured data contained some glitches and incomplete data records that have been corrected resulting in almost continuous data records from April 1991 to the present. Each data file contains all sensor information sampled at 2.34 Hz and identified by year (last digit), month (2 digits), day (2 digits) hours Zulu (2 digits) and tens of minutes to define the standard half hour file. The helium-3 NMR magnetometer measures the absolute value of the total ambient field, and at this location it is nominally 57,450 nT with slight variations associated with sensor location, i.e., sensor no. 1 measures 35 nT more than sensor no. 3, and sensor no. 2 is 10 nT less than sensor no. 3.

In addition to the total field helium sensor information, each of the three sensors has a fluxgate magnetometer. Activity indices are computed from the triaxial fluxgate magnetometers over a 23-hour period. The indices are the change in component field amplitude in nanotesla measured in a 2.5-minute period. Display software has been developed to plot the field value from all sensors and components and the gradient field from each sensor pair, i.e., 1-2, 2-3, and 1-3 for one 30-minute data segment.

THE FUTURE

The present plan is to operate the PBGMO for at least the next decade. Some upgrading is planned for the helium-3 and fluxgate magnetometers, enhancing data recording reliability, and testing experimental sensors and systems. Data reduction, which includes transferring magnetic tape cartridge data to optical disks, appears to be the most efficient storage and distribution mechanism and will be done in FY95. Software development has been started to define a set of geomagnetic noise parameters, to automatically scan through the archived data, and to select out data segments of interest for further examination.